KCAHE 2011 ANNUAL CONFERENCE

Low Energy Healthcare Design

HENDERSON ENGINEERS INC

Benchmarking energy usage

- How hospitals use energy?

- Why some facilities use more?

- What should you be using?

- Are you operating efficiently?

Energy Savings Opportunities

Existing Building Commissioning

Benchmarking energy usage

- Create baseline expectation based on 2 things.

Energy Savings Opportunities

- From knowing how hospitals use energy

Existing Building Commissioning

-Quality focused process concerning

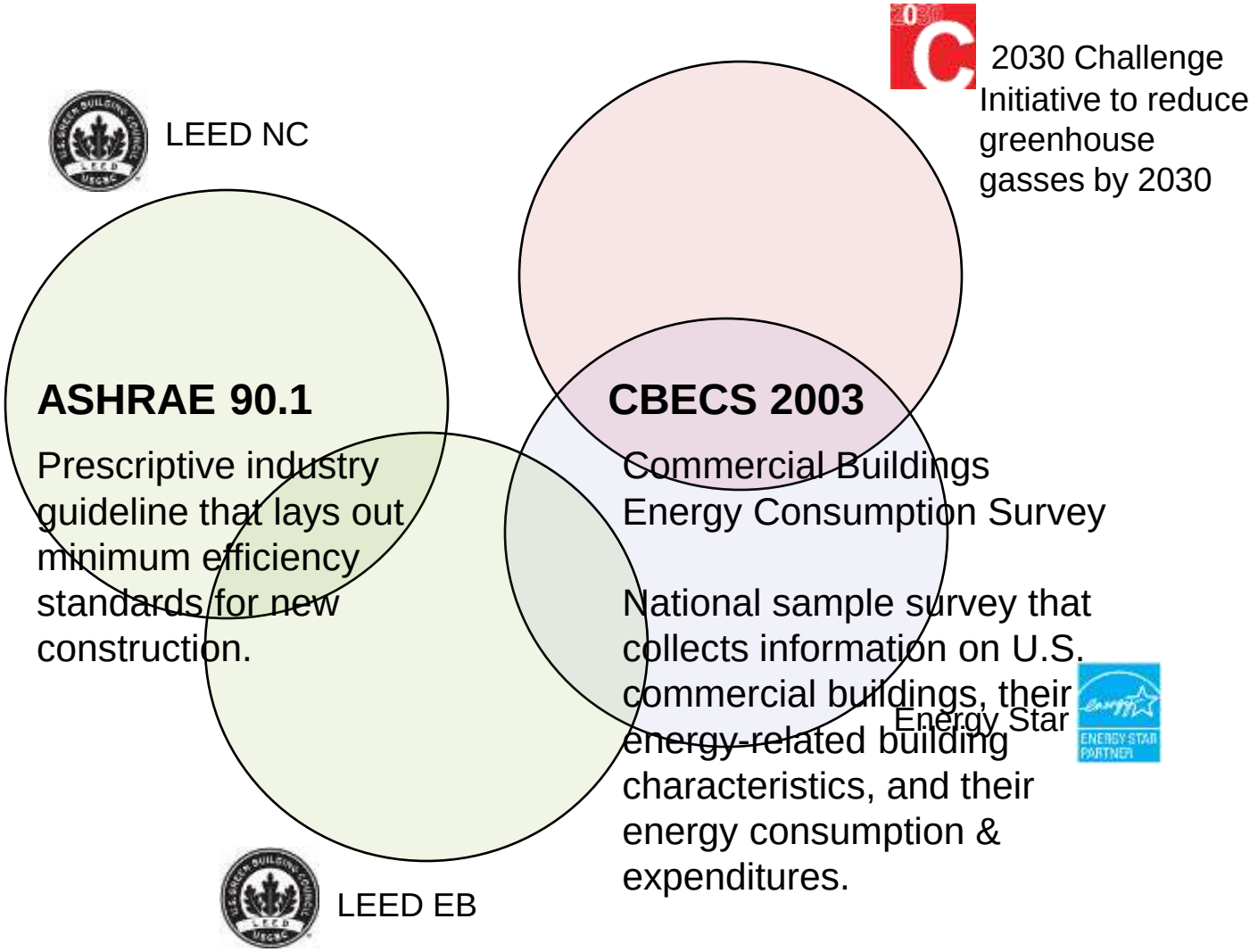
Operation and function.

Benchmarking is a process in which organizations evaluate various aspects of their processes in relation to best practice, usually within their own sector. This then allows organizations to develop plans on how to make improvements or adopt best practice, usually with the aim of increasing some aspect of performance.

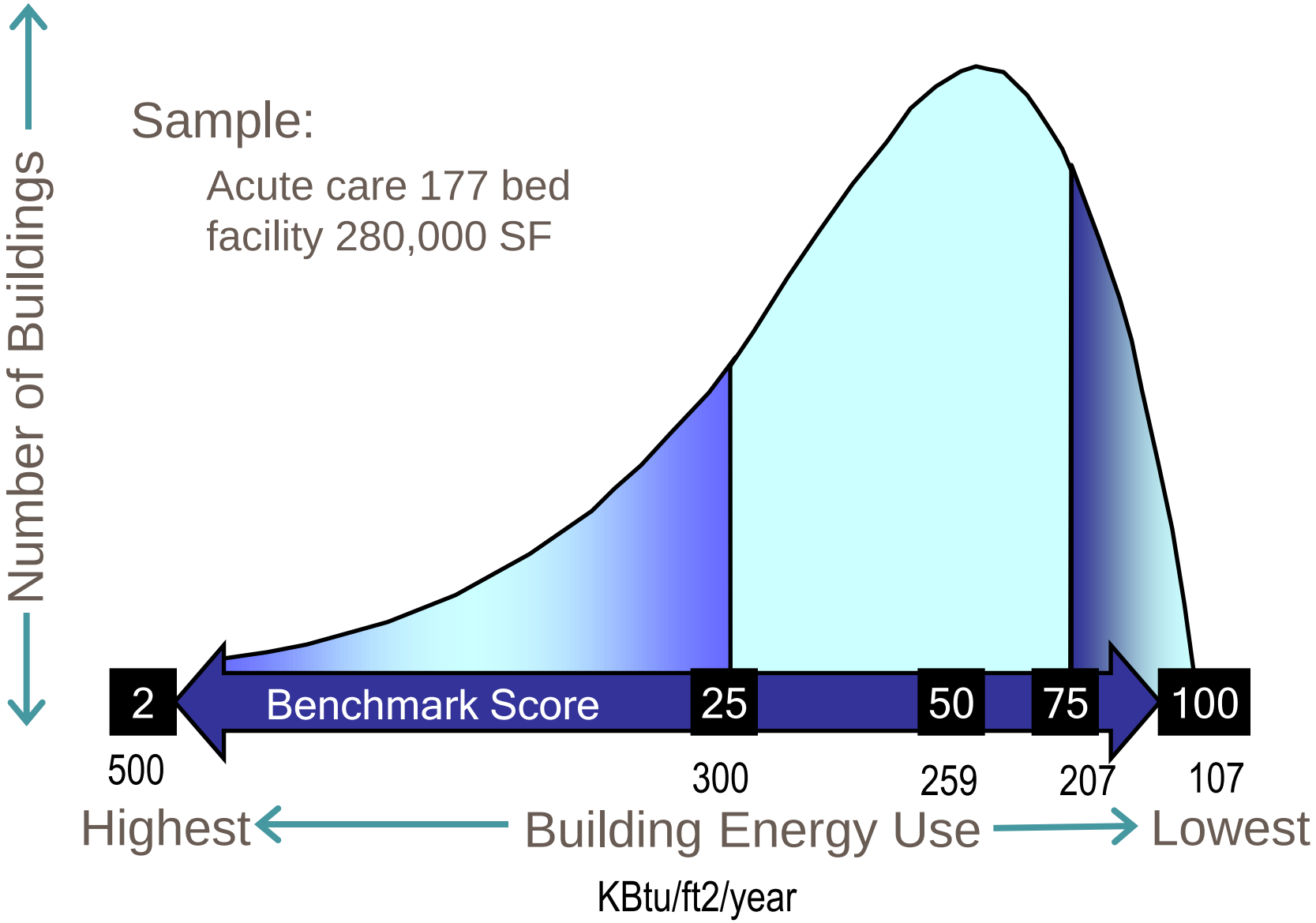
http://en.wikipedia.org/wiki/Benchmarking

Anything can be benchmarked.

Silo energy information and then compare it to peer groups.


LEED NC
2030 Challenge
Initiative to reduce greenhouse gasses by 2030
ASHRAE 90.1
Prescriptive industry guideline that lays out minimum efficiency standards for new construction.
CBECS 2003
Commercial Buildings Energy Consumption Survey
National sample survey that collects information on U.S. commercial buildings, their energy-related building characteristics, and their energy consumption & expenditures.
Energy Star
LEED EB

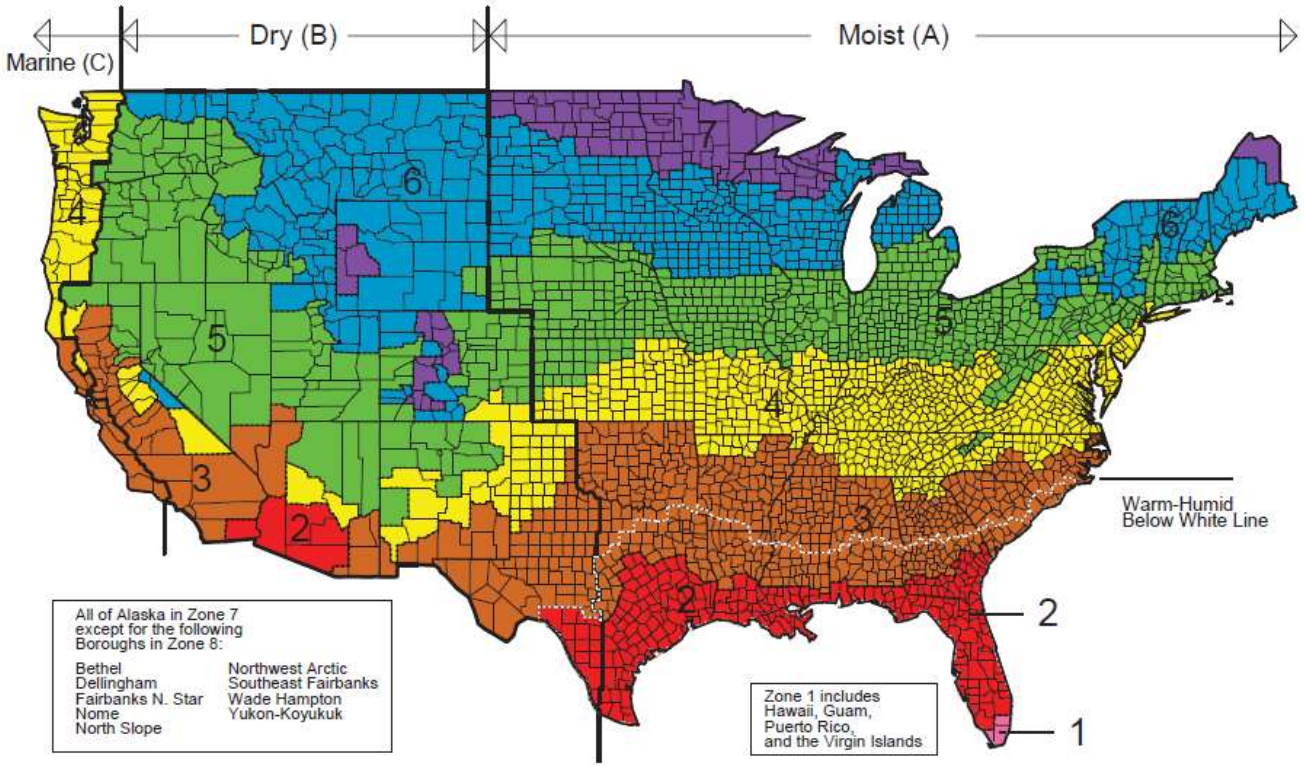
ENERGY STAR PERFORMANCE RATING SYSTEM



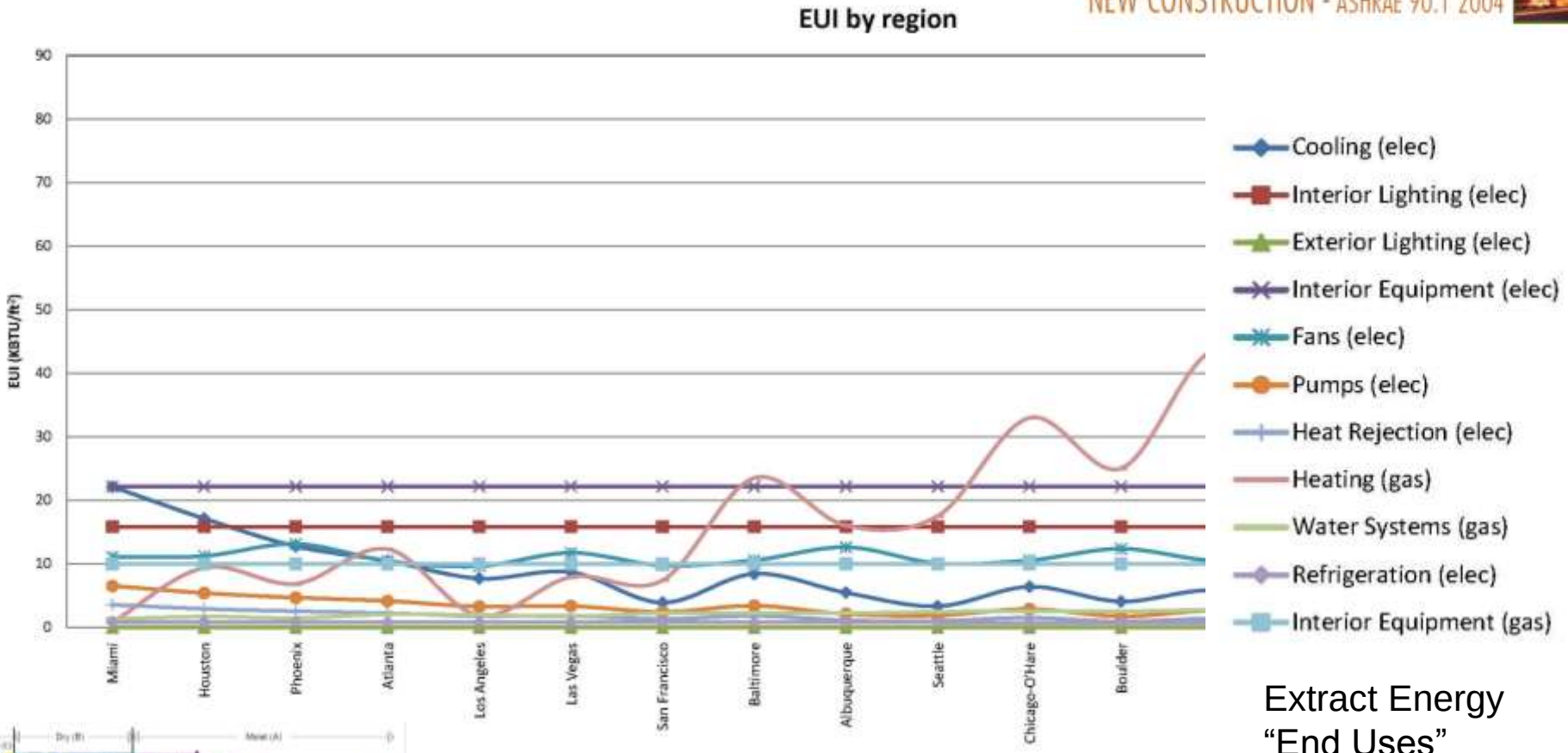
UNDERSTANDING CLIMATE ZONES

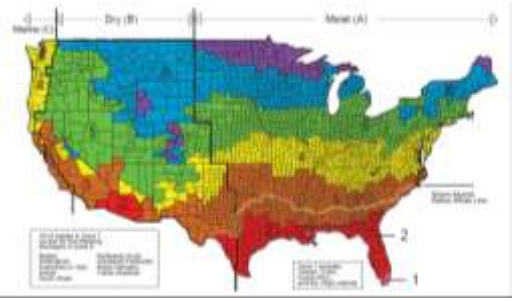
CLIMATE ZONE	REPRESENTATIVE CITY
1A	Miami, FL
2A	Houston, TX
2B	Phoenix, AZ
3A	Atlanta, GA
3B-CA	Los Angeles, CA
3B	Las Vegas, NV
3C	San Franciso, CA
4A	Baltimore, MD
4B	Albuquerque, NM
4C	Seattle, WA
5A	Chicago, IL
5B	Denver, CO
6A	Minneapolis, MN
6B	Helena, MT
7	Duluth, MN
8	Fairbanks, AK

16 CLIMATE ZONES USED TO CREATE THE BENCHMARKS



HOSPITAL
NEW CONSTRUCTION - ASHRAE 90.1 2004





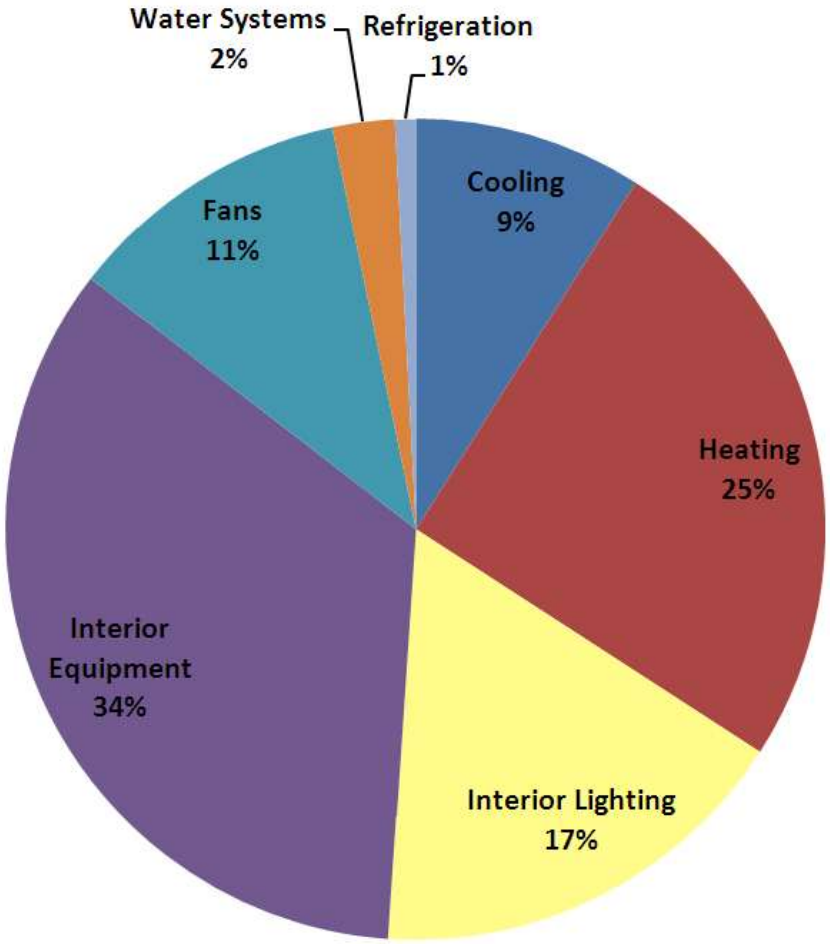
Caution when being compared to another facility!

Extract Energy "End Uses"

Emphasize:

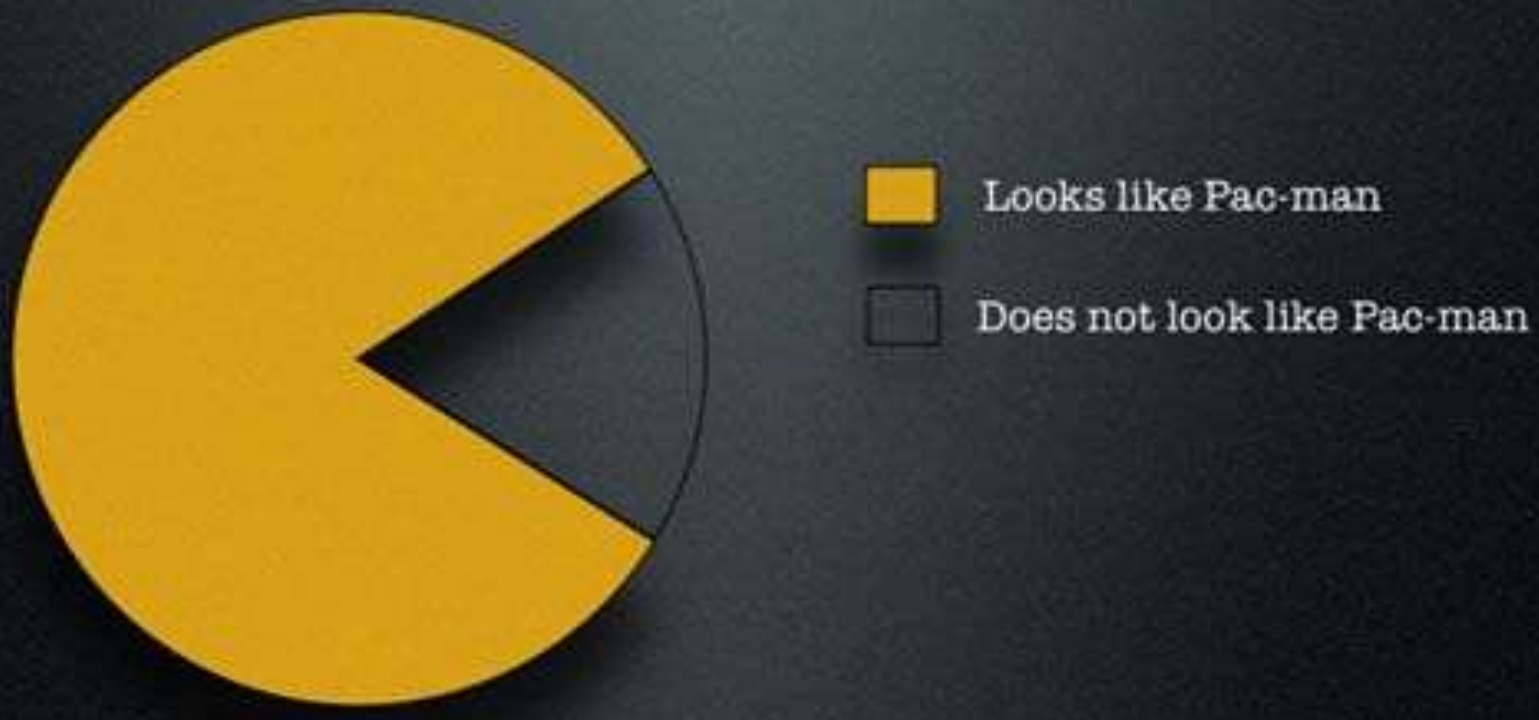
Good Building Envelopes

Office and Medical Equipment Selection



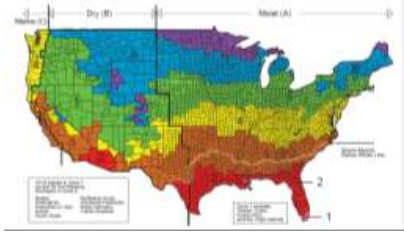
Kansas City

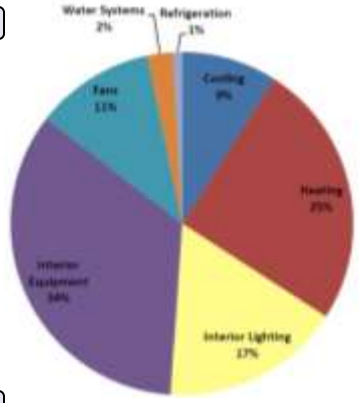
Percentage of chart which looks like Pac-man



ENERGY REDUCTION STRATEGIES BY REGION

ENERGY REDUCTION DESIGN STRATEGIES	1A	2A	2B	3A	3B-CA	3B	3C	4A	4B	4C	5A	5B	6A	6B	7	8
Maximize Daylight	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Maximize Lighting Efficiency	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lighting Controls	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
High Efficiency HVAC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Maximize Solar Shading	X	X	X	X	X	X										
Balance Passive Solar with Shading							X	X	X	X						
Maximize Passive Solar											X	X	X	X	X	X
On-site Renewable Energy																
Demand Controlled Ventilation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Infiltration Control	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Low Pressure Drop HVAC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Natural Ventilation																
Indirect Evaporative Cooling			X			X			X			X				
Economizer	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
High Efficiency Central Plant	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Efficient Owner Equipment	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Optimize Refrigeration System																
Kitchen Exhaust / Make-Up Air Optimization																
High Albedo Roof (Reflective Surface)	X	X	X	X	X	X										
Energy Management System / Energy Monitoring	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Energy/Heat Recovery	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mechanical Equipment Selected for Part Load Efficiency	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Combined Heat/Power	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Radiant Heating							X	X	X	X	X	X	X	X	X	X
Radiant Cooling																
Highly Insulated Envelope																
Commissioning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Miami	Houston	Phoenix	Atlanta	Los Angeles	Las Vegas	San Francisco	Baltimore	Albuquerque	Seattle	Chicago	Denver	Minneapolis	Helena	Duluth	Fairbanks





Benchmarking energy usage

Energy Savings Opportunities

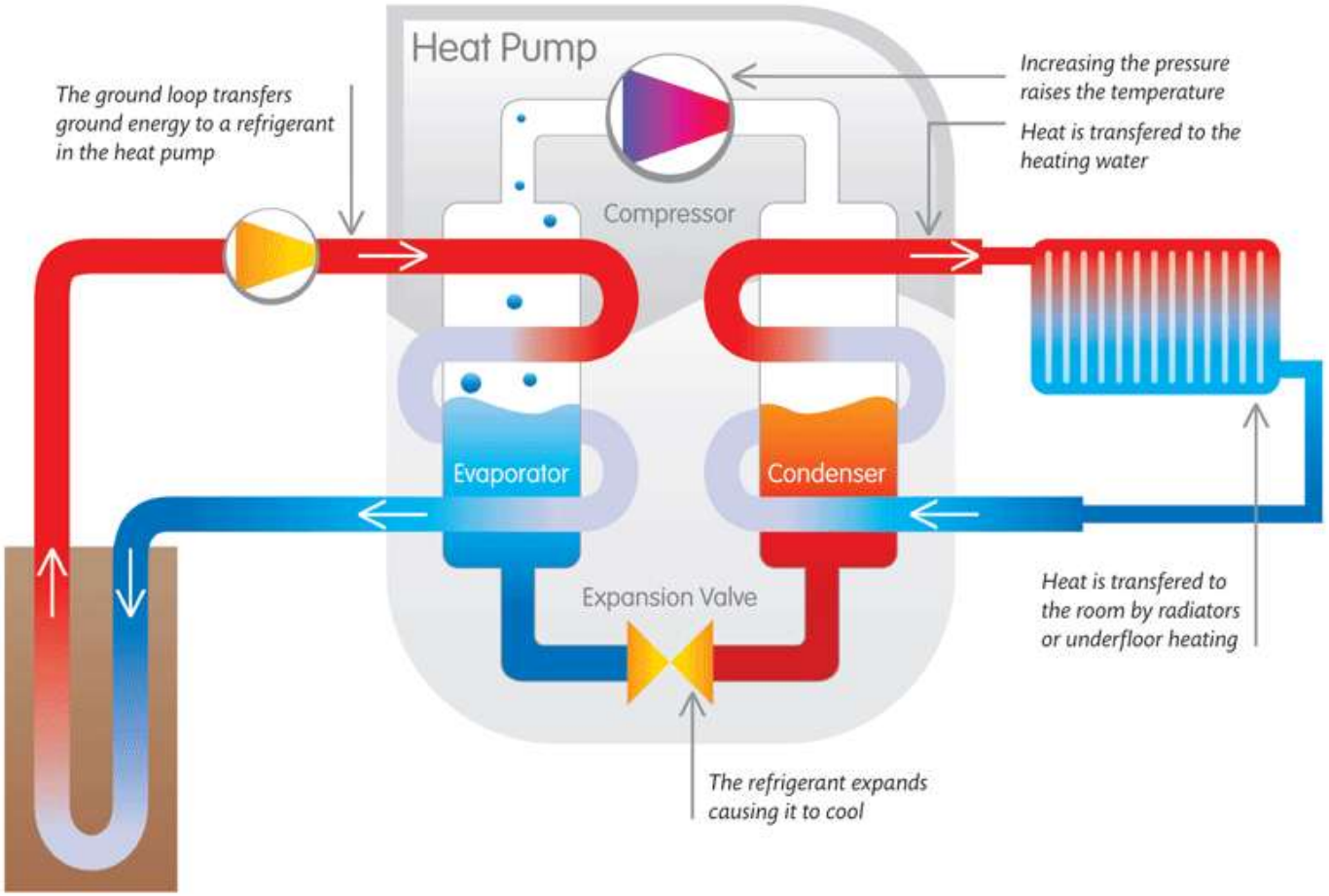
Existing Building Commissioning

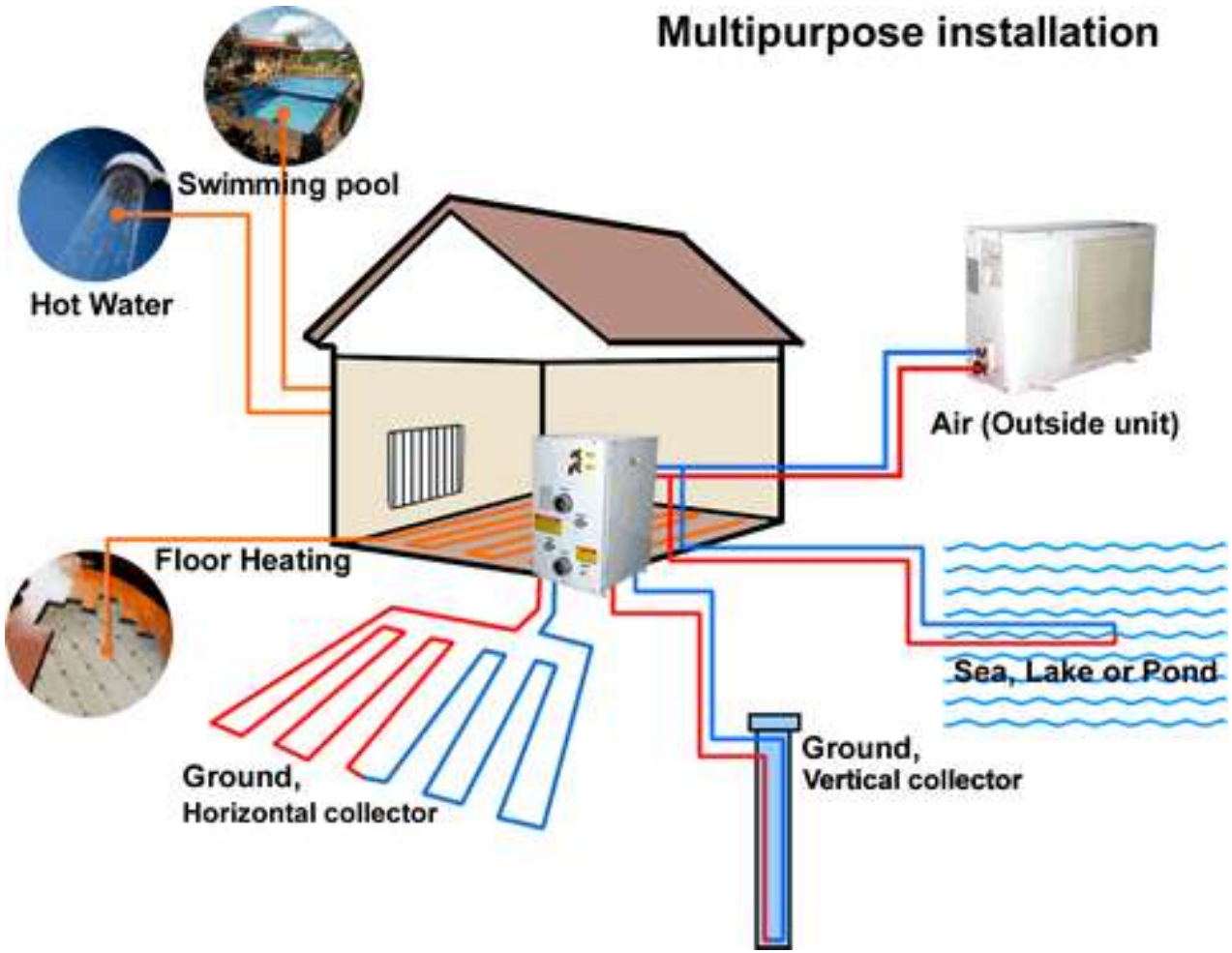
Energy Savings Opportunities

- Geoexhange systems
- Heat recovery chillers
- Small retrofit projects

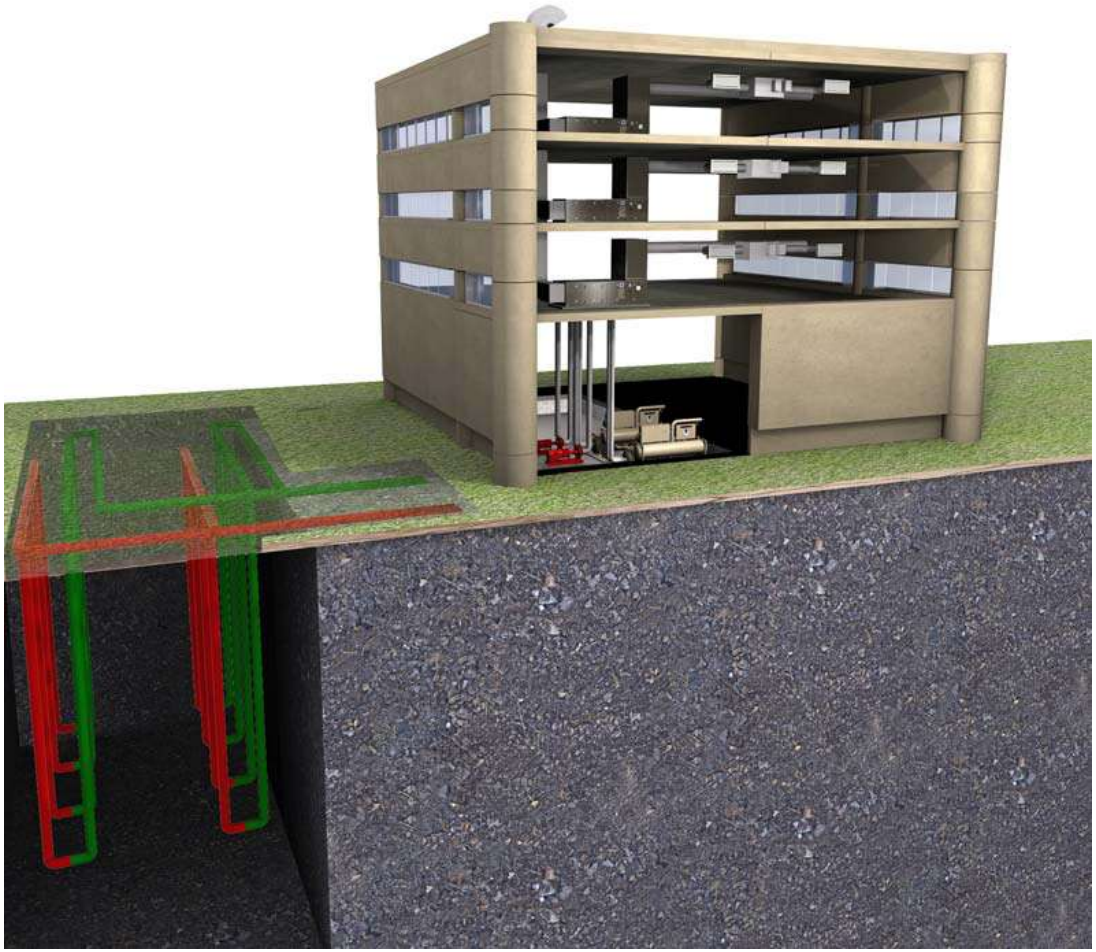
Geoexhange systems

HEAT PUMP TECHNOLOGY

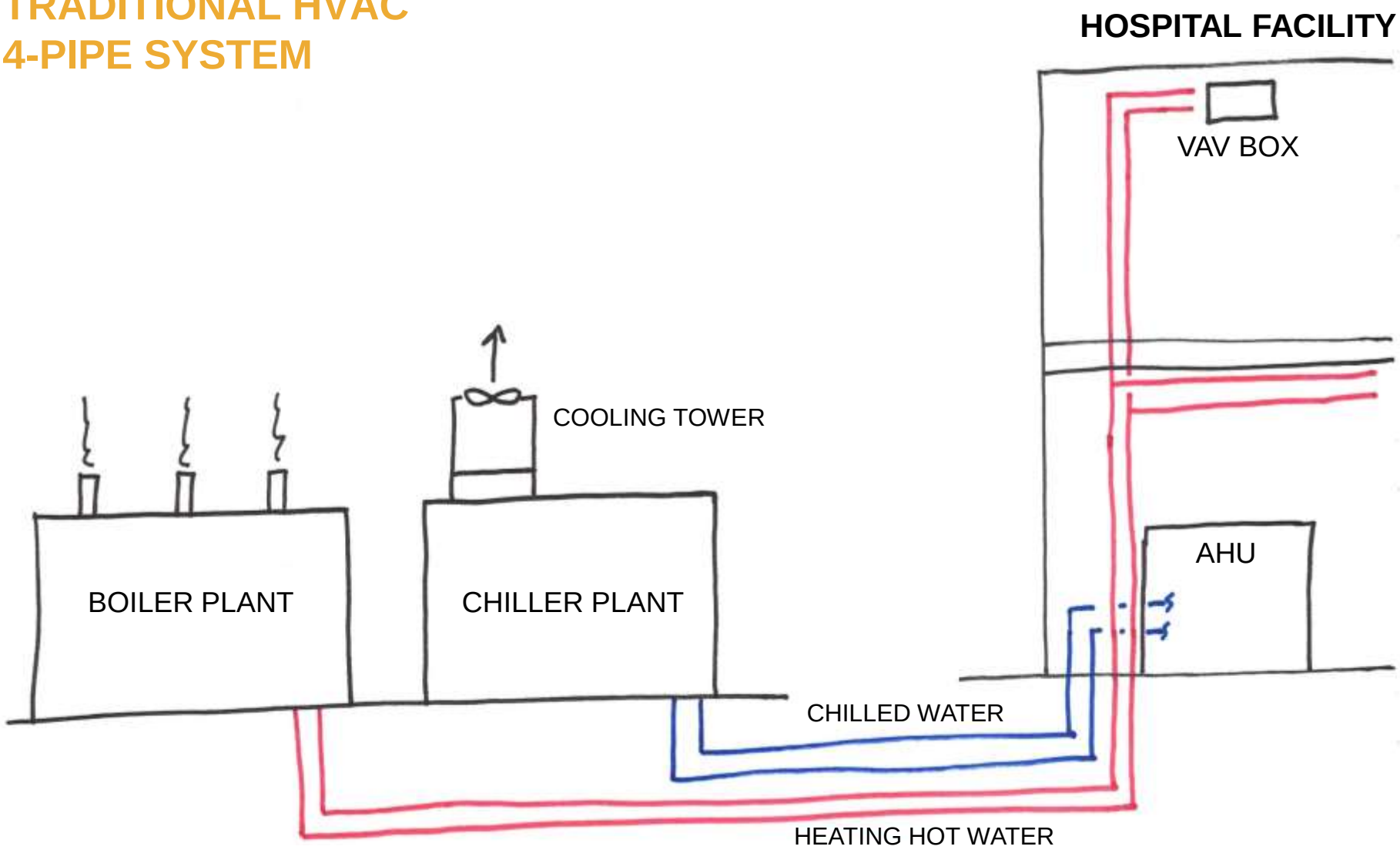



Multipurpose installation
Swimming pool
Hot Water
Air (Outside unit)
Floor Heating
Sea, Lake or Pond
Ground,
Horizontal collector
Ground,
Vertical collector

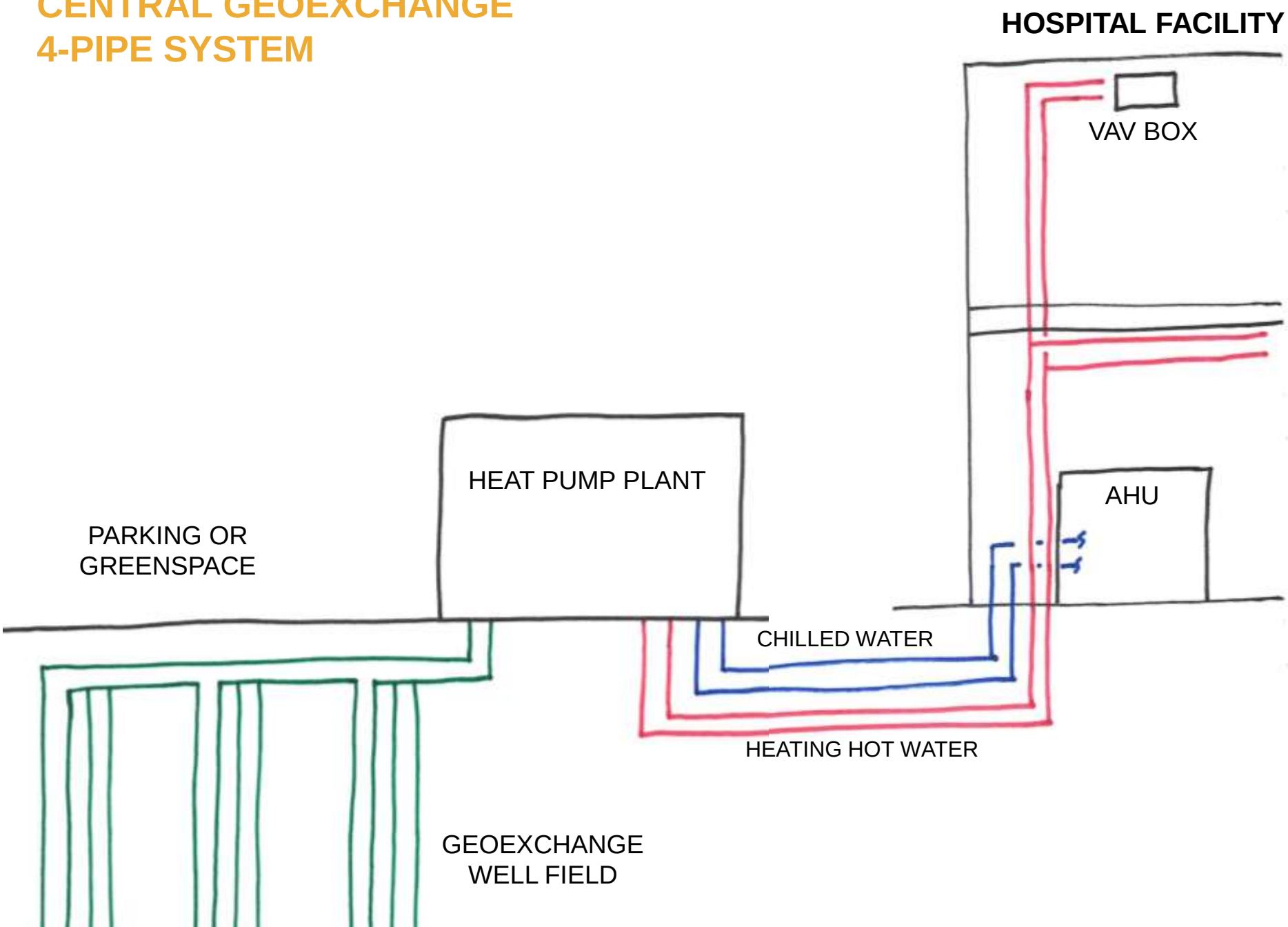
CENTRAL GEOTHERMAL SYSTEM



TRADITIONAL HVAC
4-PIPE SYSTEM



CENTRAL GEOEXCHANGE 4-PIPE SYSTEM



WATER-TO-WATER HEAT PUMPS

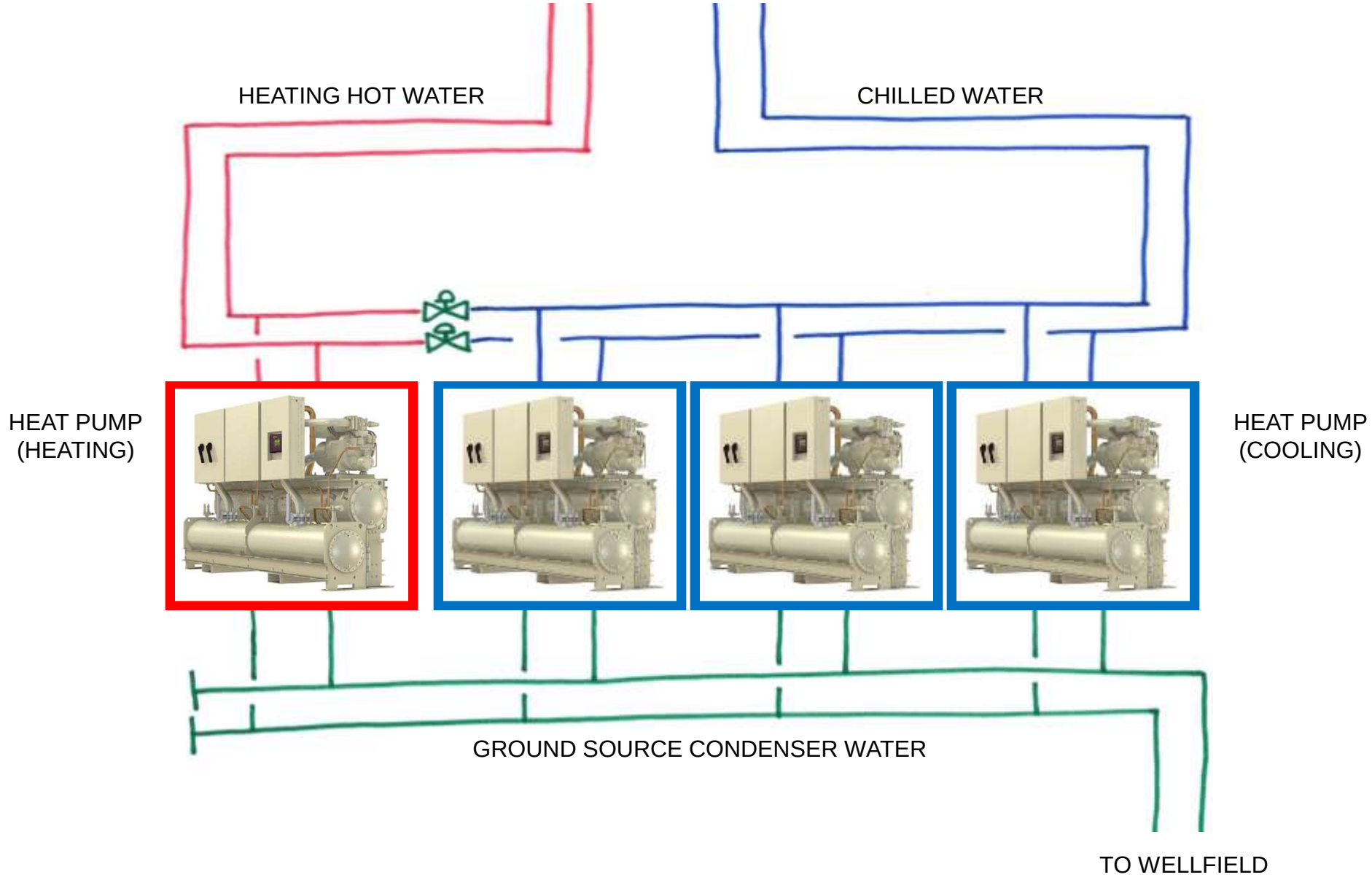
OPERATE WITH A WIDE RANGE OF CONDENSER WATER TEMPERATURES

CREATE CHILLED OR HOT WATER

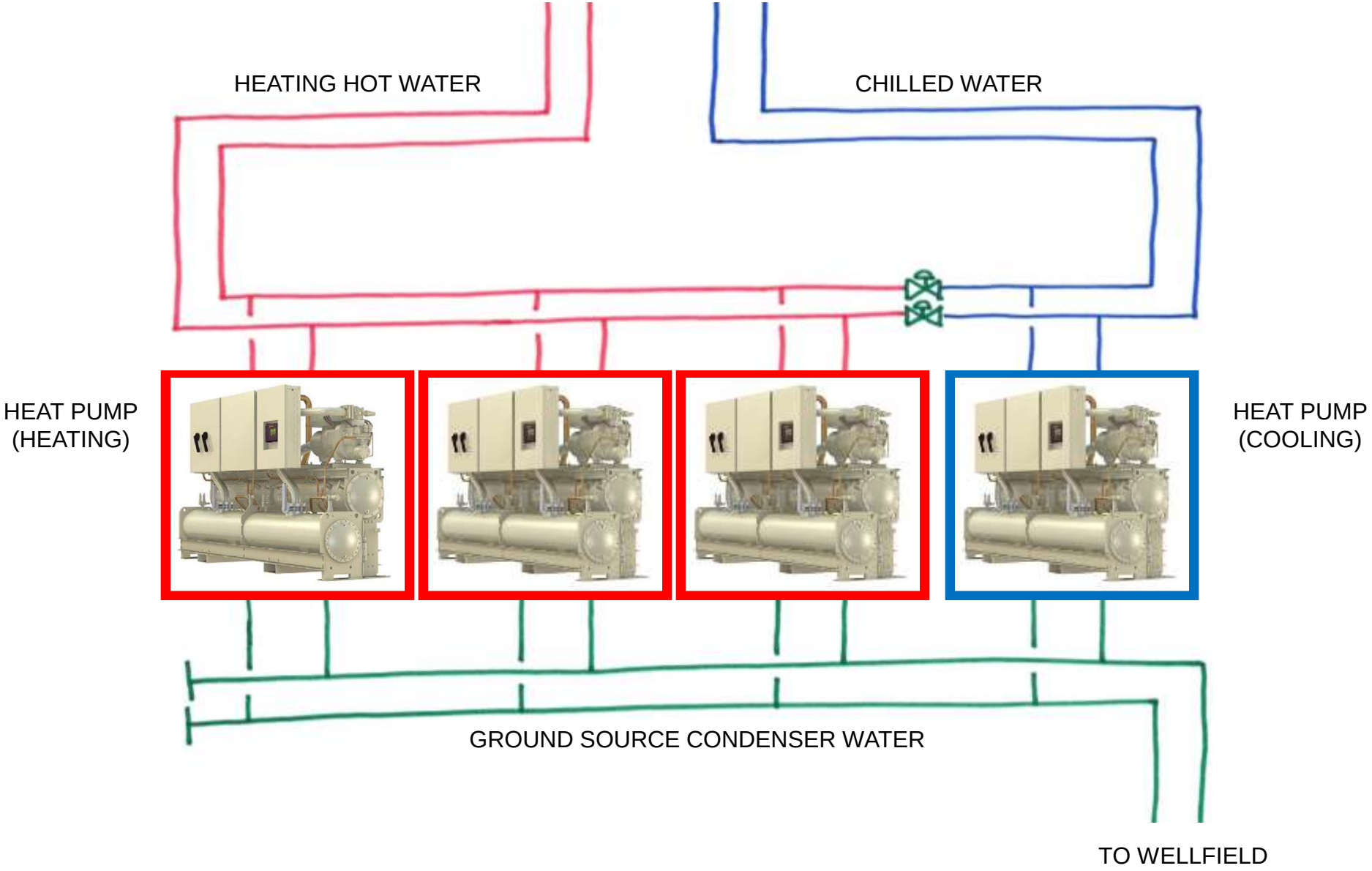
COOLING MODE: REJECTS HEAT INTO THE CONDENSER WATER LOOP (COOLING THE BUILDING)

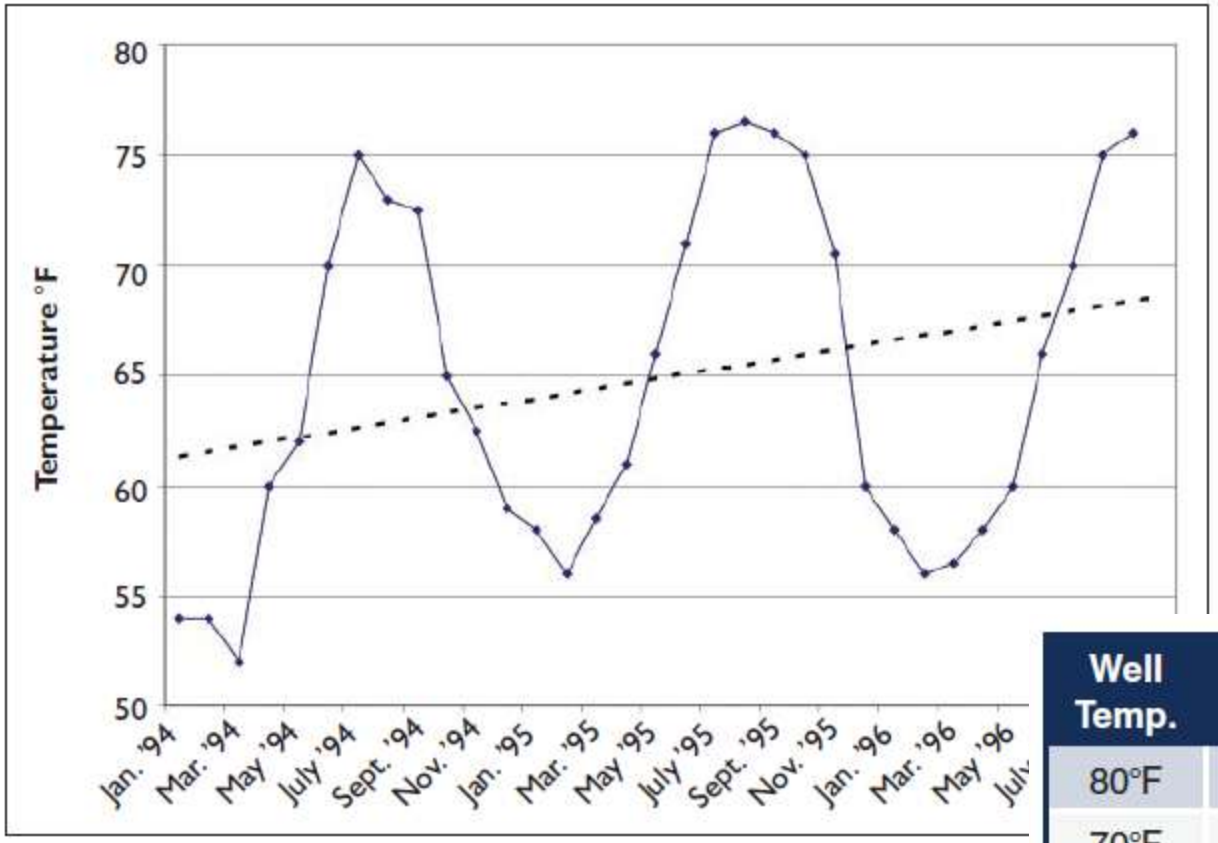
HEATING MODE: ABSORBS HEAT FROM THE CONDENSER WATER LOOP (HEATING THE BUILDING)

CENTRAL GEOTHERMAL SYSTEM
SUMMER OPERATION



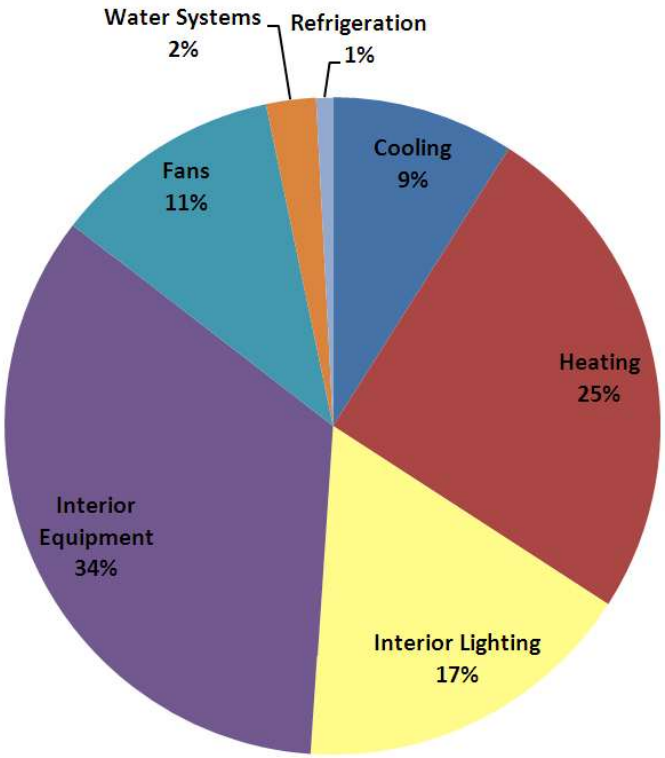
CENTRAL GEOTHERMAL SYSTEM
WINTER OPERATION





$$COP = \frac{\text{ENERGY OUT}}{\text{ENERGY IN}}$$

Well Temp.	Heating COP	Cooling COP	Cooling kW/ton
80°F	5.9	5.4	0.65
70°F	5.3	6.1	0.58
60°F	4.7	6.8*	0.52*
50°F	4.1	Free Cooling	0.00
40°F	3.7	Free Cooling	0.00


Water Systems
2%
Refrigeration
1%
Cooling
9%
Fans
11%
Heating
25%
Interior
Equipment
34%
Interior Lighting
17%

Kansas City

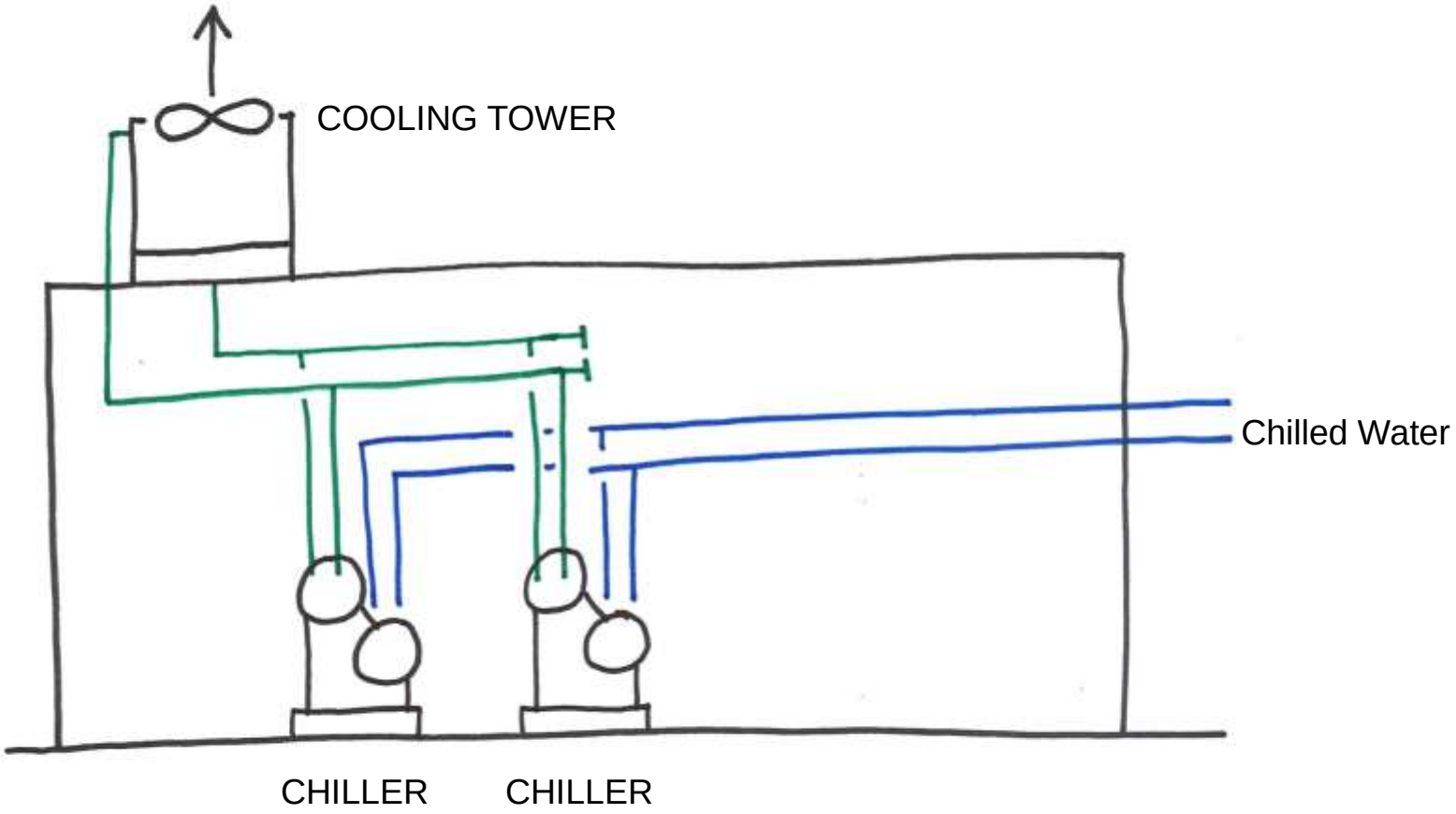
Heat Recovery Chillers

Heat Recovery Chiller Operation

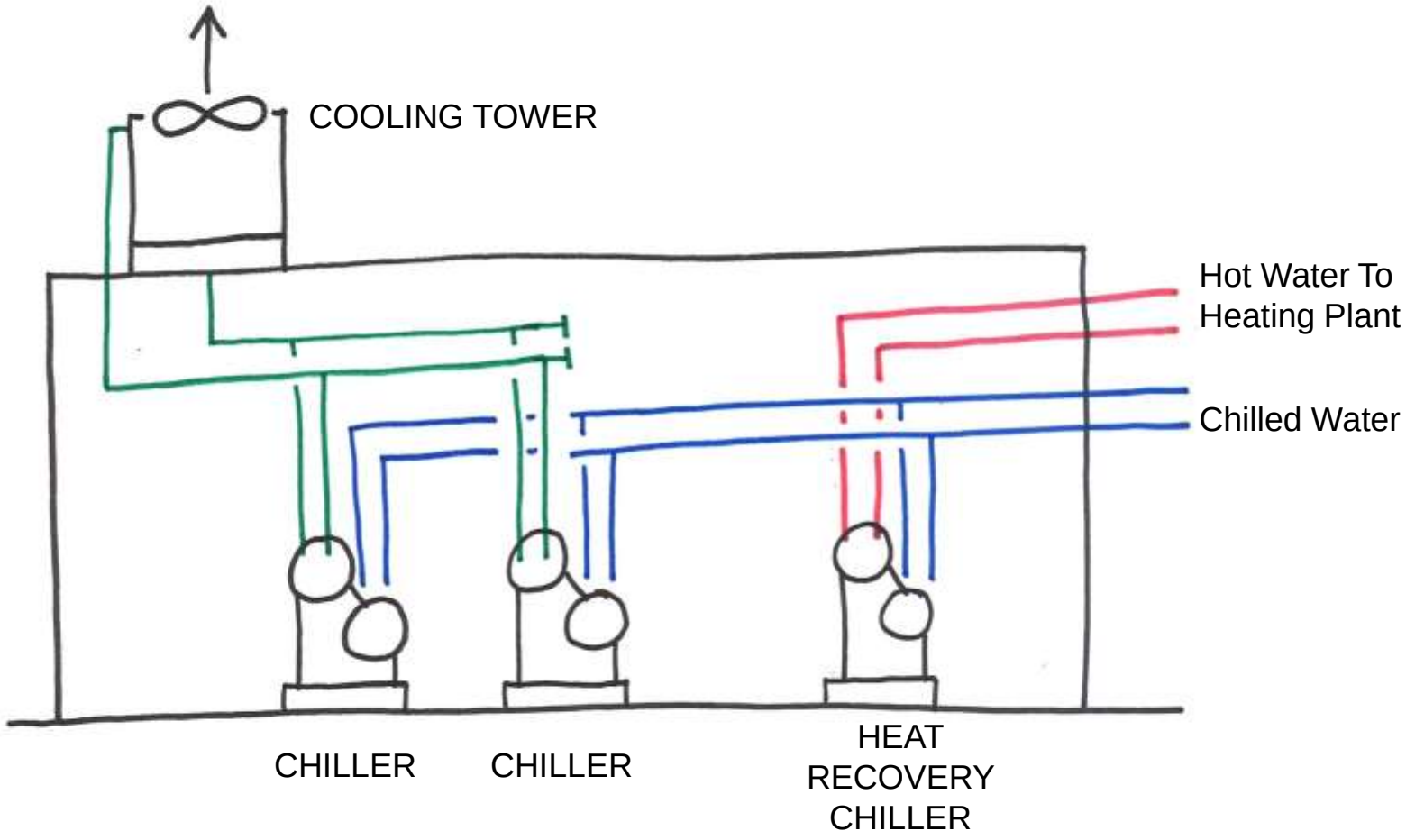
Chillers where condensers are capable of producing hot condenser water (140+ deg)

Condenser water can be used for hydronic heating, domestic water heating or other heating needs

TRADITIONAL CHILLED WATER PLANT



CHILLED WATER PLANT WITH HEAT RECOVERY CHILLER



HEAT RECOVERY CAPACITY

	COOLING PLANT CAPACITY	HEATING PLANT CAPACITY
SUMMER	**12,000 MBH (1,000 TONS)**	3,000 MBH
WINTER	3,600 MBH (300 TONS)	**10,000 MBH**

HEAT RECOVERY CAPACITY (1,000 TON CHILLER PLANT)

	COOLING PLANT CAPACITY	HEATING PLANT CAPACITY
SUMMER	12,000 MBH (1,000 TONS)	**3,000 MBH**
WINTER	**3,600 MBH (300 TONS)**	10,000 MBH

HEAT RECOVERY CAPACITY (1,000 TON CHILLER PLANT)

	COOLING PLANT CAPACITY	HEATING PLANT CAPACITY
SUMMER	12,000 MBH (1,000 TONS)	**3,000 MBH**
WINTER	**3,600 MBH (300 TONS)**	10,000 MBH

<u>COOLING PLANT</u>:

- **250 TON HEAT RECOVERY CHILLER CAPACITY**
- **750 TON TRADITIONAL COOLING PLANT CAPACITY**

<u>HEATING PLANT</u>:

- **3,000 MBH HEAT RECOVERY CHILLER CAPACITY**
- **7,000 MBH TRADITIONAL HEATING PLANT CAPACITY**

HEAT RECOVERY CAPACITY (1,000 TON CHILLER PLANT)

	COOLING PLANT CAPACITY	HEATING PLANT CAPACITY
SUMMER	12,000 MBH (1,000 TONS)	**3,000 MBH**
WINTER	**3,600 MBH (300 TONS)**	10,000 MBH

<u>THE 250 TON HEAT RECOVERY CHILLER OFFSETS THE FOLLOWING</u>:

- **250 TON CHILLER**
- **250 TON COOLING TOWER**
- **3,000 MBH BOILER**

Heat Recovery Chiller Benefits

Use rejected heat in your facility

Units provide simultaneous chilled water and hot water while only paying for one!

Optimized low-load performance

Add capacity to your existing plant

Small Retrofit projects

Boiler Burner Retrofits

- **Oxygen Stack Sensors**
- **Variable Speed Burners**

Standby Boiler Heaters

Boiler Stack Economizers

Boiler Feed Water VFDs

Heating

Chilled Water Economizers

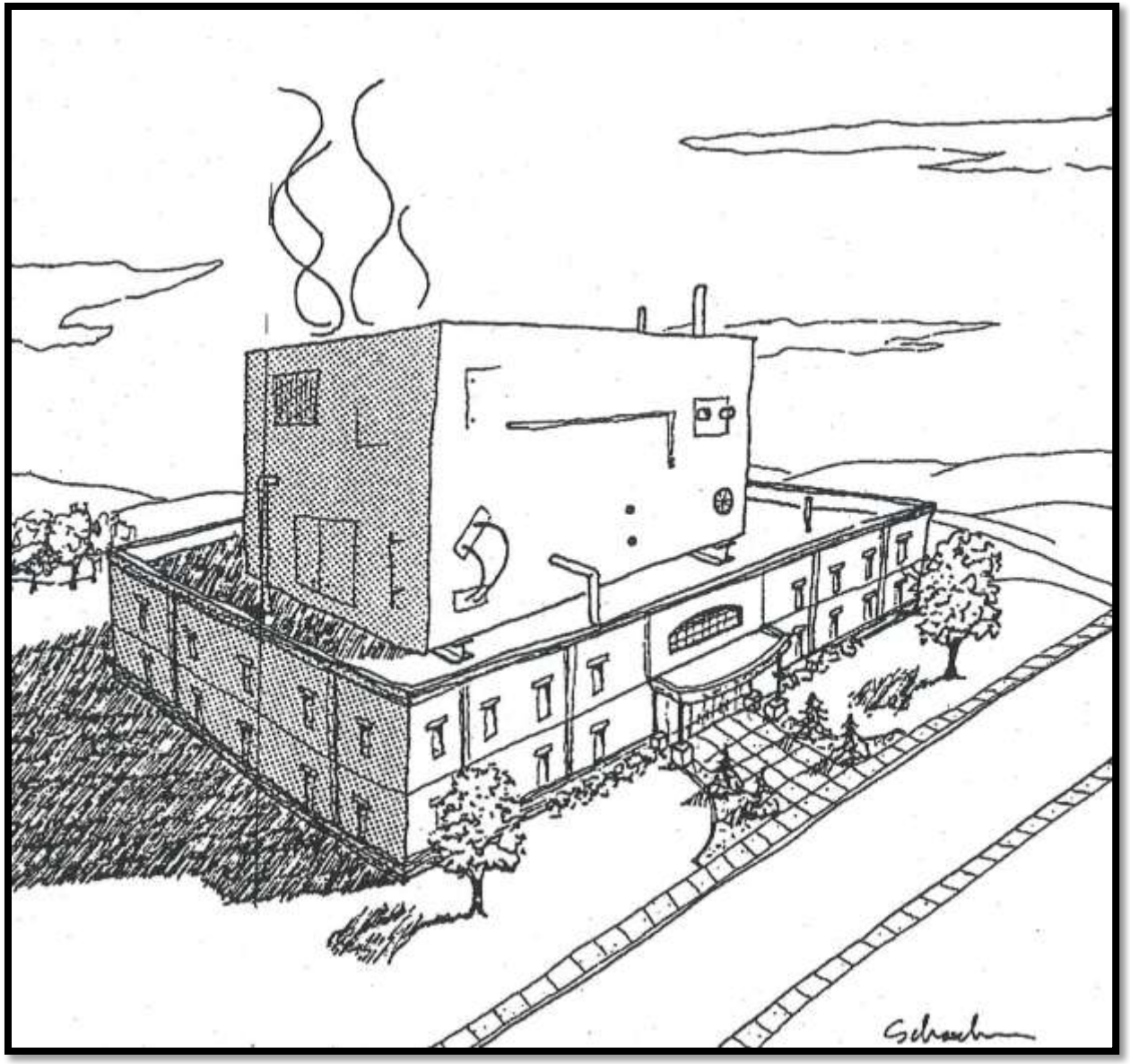
Condenser Water Heat Recovery

Optimize Delta T

VFDs on Pumping Systems

Temperature Controls

Cooling



That rooftop mechanical unit that
“No one will ever notice.”

Benchmarking energy usage

Energy Savings Opportunities

Existing Building Commissioning

How Commissioning fits into the process.

Evolved into a discipline integrated into the team from the beginning.

Owner has lots of help at the front end.

Industry (BCA / ASHRAE) is redefining how retro Cx is done.

Retro-Commissioning goals include:

- Lowering energy consumption is a natural by product of Cx
- Reducing maintenance costs
- Improving system control – one of the primary reasons for Cx calls
- Root cause analysis
- Establishing a predictable maintenance cycle

DISCOVERY | INVESTIGATION | ANALYSIS | PLANNING

Benchmarking

Benchmark current energy use:

- Examine existing billing data
- Usage is no longer theoretical.
- Provides for a natural place to begin analysis.
- Compare against:
  - Energy star
  - LEED
  - 2030 challenge

DISCOVERY	INVESTIGATION	ANALYSIS	PLANNING

Review Documentation

Compile and review existing building information:

- Drawings
- Current facility requirements (CFR)
- Sequence of operations
- Equipment list
- O&M manuals

DISCOVERY	INVESTIGATION	ANALYSIS	PLANNING

Interview

Interview Key O&M personnel:

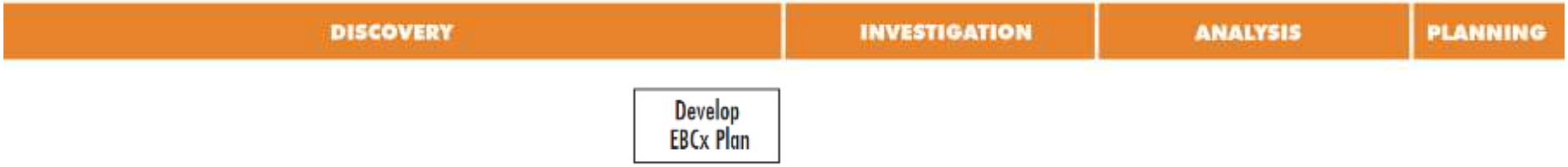
- Define problem areas
- Understand existing maintenance practices – key to energy efficiency
- Joint Commission.
- Highlight current operational issues
- Discuss standard operating procedures
- Help build consensus
- Understand facility needs and internal politics

DISCOVERY	INVESTIGATION	ANALYSIS	PLANNING

Walk Through

Perform building walkthrough:

- Examine operational needs
- Highlight potential energy conservation measures



Existing building commissioning plan defines:

- Roles and responsibilities
- The overall commissioning process
- High level project schedule
- Can everything be evaluated during business hours?

DISCOVERY	INVESTIGATION	ANALYSIS	PLANNING

Site Survey

Perform detailed site survey to:

- Fill information gaps discovered during the discovery phase
- Create a master equipment list
- Further refine potential energy conservation measures
- Create list of energy saving ideas but not yet refined.

A functional evaluation includes (not an energy audit):

- Systems diagnostic monitoring
- Functional performance testing, make sure it's working properly
- Document noted deviations
- Suggested system updates
- Conceptual engineering design
- Creation of a "master list of findings"
- Goal: To really understand how the system is actually working.

DISCOVERY	INVESTIGATION	ANALYSIS	PLANNING

Life Cycle Cost Analysis

Evaluate the master list of findings to approximate:

- Utilize test performance data to run energy model. Better than “rule of thumb”
- Energy savings potential
- Maintenance cost
- Capital cost
- Return on investment

DISCOVERY	INVESTIGATION	ANALYSIS	PLANNING

Prioritize Findings

Rank findings based on criteria established in the Current Facility Requirements (CFR).

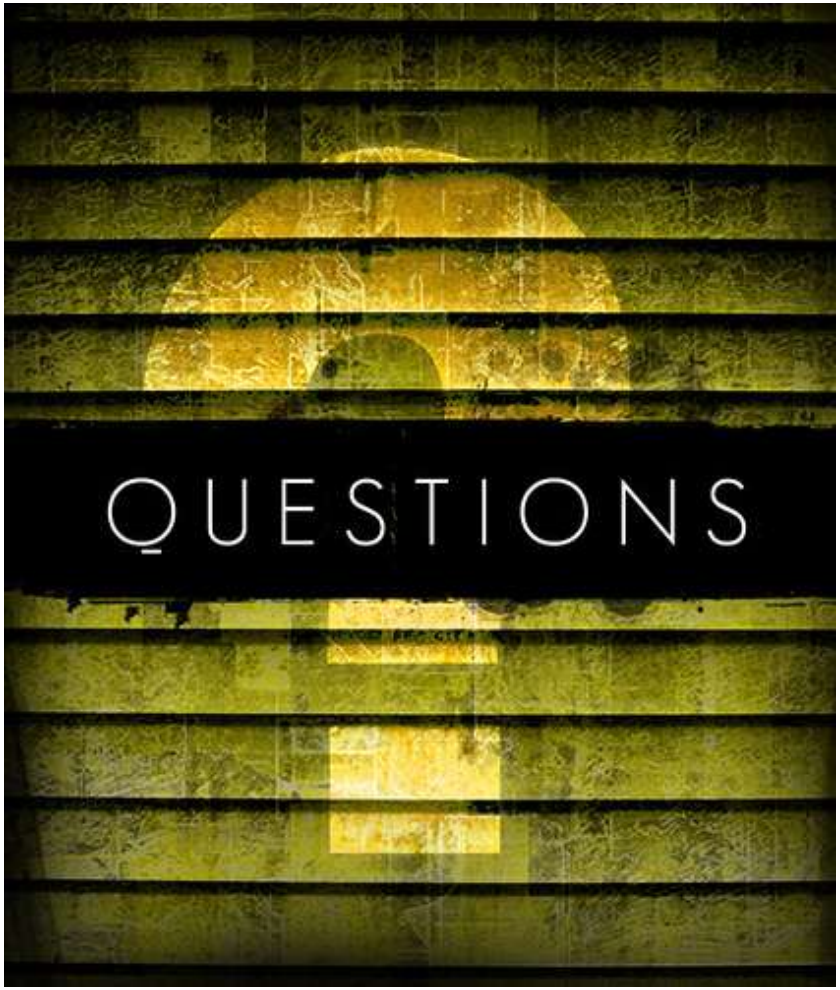
Create long range plan that:

- Plans an implementation schedule for proposed projects
- Contains a capital spending schedule
- Quantifies income streams from energy reduction

Benchmarking energy usage

Energy Savings Opportunities

Existing Building Commissioning


QUESTIONS

KCAHE 2011 ANNUAL CONFERENCE

Low Energy Healthcare Design

Thank you for your time

Contacts:

Shane Lutz: shane.lutz@hei-eng.com

Brock Centlivre: brock.centlivre@hei-eng.com

HENDERSON ENGINEERS INC